1936

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OCTOBER, 1936 LOUISIANA BULLETIN No. 279

GRAZING AND PARASITICAL STUDIES WITH CATTLE AND SHEEP

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Observations at the Louisiana Agricultural Experiment Station have shown a marked difference in the flora of pastures grazed by cattle and those grazed by sheep. In the cattle pastures, paspalum, white Dutch clover, and Bermuda were the chief forage plants. "Jimson" weeds were more or less in profusion. Just across the fence, the clovers were eaten to the ground, but sedge grass was growing in more or less abundance. This suggested the possibility of beneficial results from grazing cattle and sheep together. This procedure is looked upon with disfavor by the cattlemen, because, they say, the calves become infested with stomach worms from grazing on sheep pasture. Yet, in some areas of the state, cattle and sheep are grazed together with no apparent detrimental results. Consequently, in order to shed some light on the question of grazing and parasitic infection, a grazing experiment was begun, the objects of which were to determine:

1. The acre gains of pastures grazed by (a) cattle exclusively, (b) sheep exclusively, and (c) cattle and sheep together.
2. The effect on pasture herbage of grazing with (a) cattle, (b) sheep, and (c) cattle and sheep together.
3. The effect on pasture gains of improving native pasture by discing and sowing with Italian rye grass and clovers.
4. The parasitic infestation of calves and lambs grown under the three systems of management, namely: (a), (b), and (c).

REVIEW OF LITERATURE

Manow (1888) and Cotton (1906) were among the first to recognize the importance of grazing and the detrimental effects of over-grazing in beef cattle production. Ferris (1917), Snell (1924), and Simpson and Chase (1927) recognize the importance of grazing systems in developing pastures for livestock production. Sampson (1913) reported that deferred and rotated grazing produced the best results. Jardine (1915) used protected and unprotected plots to show the effect of over-grazing on forage growth. Jardine (1919) found that on National Forests horses and cattle made better use of grass ranges than sheep, while sheep made better use of browse, tender grass, and weeds. Cattle consumed coarse grasses and weeds. On ranges where a variety of plants grew, grazing with cattle, if not overdone, was beneficial to sheep. On ranges where weeds were numerous, grazing with sheep aided in maintaining the cattle range. Over-grazing by either cattle, sheep, or both was injurious.

Jayne (1921) found that the farmers of the Northwest favor running cattle and sheep together. Youngblood and Cox (1922) found that the ranges of the Edwards Plateau of Texas were best utilized by grazing with cattle, sheep, and goats. Walker and Lantow (1927) showed that cattle and sheep could be grazed together economically. Parr, Collier, and Klemmedson (1928) made a similar report. Bush (1930) of the Texas Station states: ". . . while sheep and cattle graze mostly on the same plants, sheep may utilize many weeds that

cattle leave untouched, while cattle can better utilize the coarser and more mature grasses . . . It has been found . . . that in the diversified grazing so highly developed on the Edwards Plateau, 20 cows, 150 ewes, and 75 goats per section (640 acres) give efficient use of the range."

Semple et al (1934) state: ". . . it is generally best to turn several kinds of livestock on a pasture and to give them only as large an area as they need." Dodd (1935) reports that for a 25-year period the average gain of pastures grazed by sheep was 103.5 pounds to the acre, while lands grazed by cattle and sheep produced 210.5 pounds of gain to the acre. Black (1921) reported a grazing season of approximately seven months for the Corn Belt.

Stevenson, Forman, and Brown (1924) reported that discing produced 1.39 tons of forage to the acre, while discing and reseeding produced 2.26 tons to the acre. Hansen (1929) found that grubbing and burning of pasture lands in Colorado improved grazing. Templeton (1929) reports that cleaning and reseeding of Mississippi pasture lands resulted in long time improvement of pastures. Archibald (1929) found fertilization and rainfall to be very important in pasture production. Bailey (1930) of Canada and Schuster (1931) of the Delaware station reported on the beneficial effects of pasture fertilization.

Internal parasites, particularly stomach worms, have played havoc with the sheep industry in various states. Various stations, including the United States Department of Agriculture, have reported the destructive effect of this parasite, and many have recommended drenching with bluestone as a control measure. (See Bibliography, references 35, 37, 41, 42, 45, 47, 49, 50, 52, 53, 54, 55, 56, 57, 58, 59, and 60). Dalrymple (1905) and Bell (1922, 1923) found that lambs could be raised in a barn or on a bare lot and suffer very little from parasitic infestation. However, these systems do not seem to be practical for commercial production. Bell and Warwick (1928) found that the feeding of tobacco, either in the feed or mixed with salt, was ineffective in controlling stomach worms. Nicotine sulphate was also ineffective when fed in the salt. Boughton and Hardy (1934) found that salt containing bluestone (copper sulphate) produced chronic copper poisoning after from five to twelve months.

Green (1935) states that sheep cannot be concentrated on improved pastures on account of the sheep becoming infested with internal parasites. Dikmans (1923) examined the stomachs of two hundred head of cattle slaughtered at the Baton Rouge, Louisiana, City abattoir. From this examination he estimated that from 75 to 80 per cent of all the calves slaughtered at this abattoir harbor stomach worms. Eighty per cent of the calves killed were infested with hookworms.

PASTURE GAINS OF CATTLE AND SHEEP

Discing and Seeding

The bottom lands adjacent to the lower Mississippi river, sometimes called "Delta" or "riverfront," are composed of rich alluvial soils capable of producing excellent pastures if properly cared for. Bermuda, Dallis grass, Vasey grass, carpet grass, white Dutch clover, black medic, and other grazing crops grow wild and make a luxuriant growth. Italian rye grass, Persian clover, red top, and other grazing or forage plants make good growth when planted.

The first attempt of the Louisiana Agricultural Experiment station to get data on the productive capacity of riverfront lands was made in 1931 on a field of 26.5 acres (Bray, 1933). This piece of land had been planted in corn and soybeans in 1928, followed by winter oats. In February, 1929, white Dutch clover was seeded on the oats. In 1931 this land had a very heavy stand of clover and Bermuda. From March 23 to October 13 this pasture carried 38 head of cattle, mostly yearling heifers, and produced a total gain of 9,900 pounds, or 372 pounds per acre. The average daily gain for this group of cattle was 1.5 pounds per animal up to August 3. After this date and with fewer cattle on the pasture, the average daily gain was 0.83 pounds per animal.

In the fall of 1930-31, Bray (1933) fenced and drained a 22.8 acre black land pasture. This pasture had been in cultivation but had grown up with sedges and water grass with only a small amount of white Dutch clover and Bermuda. During the grazing season of 1931 this pasture carried an average of 13.3 cattle and made a gain of 69 pounds per acre. In the fall of this year (1931) the pasture was divided into two equal lots of 11.4 acres each for experimental purposes. Both lots were mowed. Lot I received no further treatment, but lot II was disced and seeded with 6 pounds of white Dutch clover, 9 pounds of red top, and 9 pounds of Italian rye grass per acre. A small amount of Bermuda grass seed was scattered in areas where no Bermuda was growing. Records of the number of cattle grazed, the beef produced per acre and the average daily gains for the years 1932 and 1933, together with the record of 1931, are shown in table I.

TABLE I. Discing and Seeding Improves Pastures.
(1931-1932)

	Lots I and II, undivided	Lot I Mowed	Lot II Disced, Seeded & Mowed
Number of acres	22.8	11.4	11.4
Average number of cattle			
1931—April 17 to Sept. 12	13.2	----	----
1932—March 19 to Sept. 29	----	9.75	13.5
1933—March 30 to————	----	14.0 Oct. 25	11.7 Oct. 6
Beef produced per acre:			
1931	69.4	----	----
1932	----	174.2	231.6
1933	----	148.6	264.8
Average daily gains:			
1931	.80	----	----
1932	----	1.05	1.00
1933	----	.75	1.03

This table shows that mowing, discing, and seeding produces a marked effect upon the productive capacity of these pastures. The productive capacity in 1931 was very low, being only 69.4 pounds per acre. In 1932, the unimproved portion (lot I) of this pasture produced 174.2 pounds of beef per acre, while the improved half (lot II) produced 231.6 pounds per acre. In 1933, lot I produced 148.6 pounds of beef per acre, and lot II, 264.8 pounds of beef, showing quite conclusively that discing and seeding results in marked increases in gain.

PASTURE IMPROVEMENT FOR CATTLE AND SHEEP

In 1933 a similar experiment was started with sheep. An unimproved pasture, lot IV, was grazed with ewes and lambs. A similar pasture, lot V, was improved by discing and seeding to Italian rye grass and white Dutch clover and was grazed with ewes and lambs. An additional pasture, lot III, was grazed with cows, calves, ewes, and lambs. This last lot was added to the experiment because observations had shown that pastures grazed with cattle had good stands of clover but were weedy, while sheep pasture just across the fence had no weeds, very little clover, but a heavy growth of coarse grass that the sheep would not eat. Cattle and sheep had never been grazed together at Louisiana State University because of the rather pronounced opinion among cattlemen that calves become infested with stomach worms and other internal parasites from sheep. In order to get some data on this particular point, a group of cows and calves were weighed, grazed on the university cattle pasture, and used as a check against lot III. This group of cows and calves was called lot VI. The pasture gains of these six lots are shown in table II.

TABLE II. Summary of Pasture Gains Made by (a) Cattle and Sheep, (b) Cattle on Native Pasture, (c) Cattle on Improved Pasture, (d) Sheep on Native Pasture, and (e) Sheep on Improved Pasture[1], 1933.

Lot		I	II	III	IV	V	VI
Area, acres		11.25	11.25	17	7.833	10.9816	-------
Number of Animals per lot	Cows	11.7[2]	14.0[2]	12	-------	-------	12
	Calves	-------	-------	12	-------	-------	12
	Ewes	-------	-------	16/19[3]	16/20	33/39	-------
	Lambs	-------	-------	12	11	23[4]	-------
Initial weight per animal, pounds	Cows	-------	-------	806.2	-------	-------	785.8
	Calves	-------	-------	198.5	-------	-------	197.6
	Ewes	-------	-------	97.1	79.1	80.1	-------
	Lambs	-------	-------	33.1	37.7	32.3	-------
Final weight per animal, pounds	Cows	-------	-------	850.8	-------	-------	862.6
	Calves	-------	-------	415.7	-------	-------	426.2
	Ewes	-------	-------	94.4	75.7	80.2	-------
	Lambs	-------	-------	63.1	51.8	54.9	-------
Gain in weight per animal, pounds	Cows	-------	-------	44.6	-------	-------	76.8
	Calves	-------	-------	217.2	-------	-------	228.6
	Ewes	-------	-------	—2.7	—3.4	.1	-------
	Lambs	-------	-------	30.0	14.1	22.6	-------
Gain in weight per acre, pounds	Cows	148.6	264.8	31.5	-------	-------	-------
	Calves	-------	-------	153.3	-------	-------	-------
	Ewes	-------	-------	—1.9	—11.36	—6.39	-------
	Lambs	-------	-------	21.6	29.49	53.09	-------
Total pounds per acre		148.6	264.8	204.5	18.13	46.7	-------
Marketable gains per acre, pounds	Calves	-------	-------	153.3	-------	-------	-------
	Lambs	-------	-------	21.6	29.49	53.09	-------
Total		148.6	264.8	174.9	29.5	53.1	-------
Value of Marketable gains per acre at 7c per pound		$10.40	$18.51	$12.34	$2.07	$3.62	-------

[1]Grazing period: Cattle, lots I, March 30 to October 6.
II, March 30 to October 25.
III, April 19 to September 15.
Sheep, lots III, IV, and V, April 12 to October 13.

[2]Yearling heifers.

[3]Ewes were added to lots III, IV, and V on September 15, 1933.

[4]One lamb died August 10, in Lot V.

Lots I and II, as previously shown, produced 148.6 and 264.8 pounds of gain per acre. Lot III, grazed by cattle and sheep, produced 204.5 pounds of gain. The gains of these three lots are not comparable, because yearling heifers were used in lots I and II, while cows, calves, ewes, and lambs were used in Lot III. Yet lot III shows considerably more gain per acre than lot I, a comparable plot of land. The gains per acre of the sheep lots IV and V are 18.13 and 48.7 pounds respectively. This indicates the unprofitableness of grazing a river front pasture with sheep alone. The final weights of the calves in lots III and VI do not show any detrimental effects of grazing cattle and sheep together. On the contrary, the final weights of the lambs in lots III, IV and V indicate a beneficial effect for the lambs, the lot III lambs grazed with cattle averaging 63.1 pounds in weight, as compared to 51.8 and 54.9 pounds for the other two lots.

In 1934 the experiment was set up as a five lot experiment, starting March 26 and closing October 25, which made a 214 day grazing period for all lots. Cows and calves were used in lots I, II, and III and ewes and lambs in lots III, IV, and V. The data for 1934 are summarized in table III.

Figure 1—Calves averaging 477 pounds the first of November, produced on pasture grazed by cattle and sheep.

TABLE III. Summary of Pasture Gains Made by (a) Cattle, (b) Cattle and Sheep and (c) Sheep on Improved and Native Pasture, 1934. Grazing period, March 26 to October 25, 214 days.

Lot		I	II	III	IV	V
Area, acres		11.25	11.25	17.0	7.833	10.9816
Number of animals in lot	Cows	6	8	10	-------	-------
	Calves	6	8	10	-------	-------
	Ewes	-------	-------	12	6	15
	Lambs	-------	-------	10	5	14
Initial weight per animal, pounds	Cows	720	742	754	-------	-------
	Calves	109	107	101	-------	-------
	Ewes	-------	-------	70	73	76
	Lambs	-------	-------	15	13	15
Final weight per animal, pounds	Cows	843	880	914	-------	-------
	Calves	384	380	415	-------	-------
	Ewes	-------	-------	97	75	80
	Lambs	-------	-------	65	44	45
Gain in weight per animal, pounds	Cows	123	136	160	-------	-------
	Calves	275	273	314	-------	-------
	Ewes	-------	-------	27	2	4
	Lambs	-------	-------	50	31.1	30
Gain in weight per acre	Cows	65	116	94	-------	-------
	Calves	156	193	185	-------	-------
	Ewes	-------	-------	19	2	6
	Lambs	-------	-------	30	20	38
Total, pounds		221	309	328	22	44
Marketable gain per acre	Calves	156	193	184	-------	-------
	Lambs	-------	-------	30	20	38
Total marketable gain per acre		156	193	214	20	38
Value of marketable gain per acre at 7c per pound		$10.92	$13.51	$14.98	$1.40	$2.66

Figure 2—Grazing cattle and sheep together produced healthy 63 pound lambs at weaning time, few parasites, and good pasture utilization.

Both calves and lambs in lot III were heavier than the calves and lambs in the other lots, indicating the beneficial effect of grazing cattle and sheep

together. The total gains per acre were 221 pounds, 309 pounds, 328 pounds, 22 pounds, and 44 pounds respectively for lots I, II, III, IV and V. The marketable gains per acre were 156 pounds, 193 pounds, 214 pounds, 20 pounds, and 38 pounds respectively for the five lots. These figures indicate the beneficial effect of discing and seeding pastures, the beneficial effect of grazing cattle and sheep together, and the poor return from grazing river front pasture with sheep alone.

The grazing project was set up in 1935 in a manner very similar to that used in 1934. Six cows and six calves were used in lot I, eight cows and eight calves in lot II, ten cows, ten calves, twelve ewes and seven lambs in lot III, six ewes and six lambs in lot IV, and eighteen ewes and nine lambs in lot V. The results are summarized in table IV.

TABLE IV. Summary of Pasture Gains Made by (a) Cattle, (b) Cattle and Sheep, and (c) Sheep on Native and Improved Pasture During the Grazing Season of 1935. March 28 to October 30—216 days.

Lot		I	II	III	IV	V
Area, acres		11.25	11.25	17.0	7.833	10.98
Number of animals per lot	Cows	6	8	10	-------	-------
	Calves	6	8	10	-------	-------
	Ewes	-------	-------	12	6	18
	Lambs	-------	-------	7	6	9
Initial weight per animal	Cows	724.7	717.0	767.9	-------	-------
	Calves	122.9	120.4	124.8	-------	-------
	Ewes	-------	-------	71.5	71.0	68.6
	Lambs	-------	-------	22.9	23.1	23.8
Final weight per animal, pounds	Cows	879.7	926.3	956.0	-------	-------
	Calves	397.8	419.2	477.3	-------	-------
	Ewes	-------	-------	91.6	67.7	69.8
	Lambs	-------	-------	61.0	42.1*	48.7*
Gain in weight per animal, pounds	Cows	155	209	188	-------	-------
	Calves	275	299	353	-------	-------
	Ewes	-------	-------	20	—3.3	1.2
	Lambs	-------	-------	38	19.0	25.0
Gain in weight per acre, pounds	Cows	82.67	148.80	110.71	-------	-------
	Calves	146.58	212.44	207.35	-------	-------
	Ewes	-------	-------	14.24	—2.55	—10.65
	Lambs	-------	-------	17.06	3.83	—10.65
Total		229.25	361.24	349.36	1.28	—21.30
Marketable gains per acre, pounds	Calves	146.58	212.44	207.35	-------	-------
	Lambs	-------	-------	17.06	3.83	—10.65
Total		146.58	212.44	224.41	3.83	—10.65

* Lot IV, two lambs died. Lot V, two ewes and eight lambs died.

Again the calves and lambs in lot III averaged heavier than the calves and lambs in the other lots. Lot III likewise produced more marketable gains per acre than any other lot, although lot II produced more total gain. The marketable gains for the five lots are 147 pounds, 212 pounds, 224 pounds, 3.83 pounds, and —10.7 pounds for lots I to V, respectively. The low gains in lots IV and V are due in part to deaths in these lots. Two lambs died in lot IV and two ewes and eight lambs in lot V died during the 1935 grazing season.

The amount of gains to the acre over the five years is shown in table V.

TABLE V. Gains per Acre of Pasture, 1931-1935.

Lot	I Cattle, Native Pasture	II Cattle, Improved Pasture	III Cattle & Sheep, Native Pasture	IV Sheep, Native Pasture	V Sheep, Improved Pasture
	Total Gains per Acre, Pounds.				
Year:					
1931	69.4	69.4			
1932	174.2	231.6			
1933	148.6	264.8	204.5	18.1	46.7
Av., '32-'33	161.4	248.2	204.5	18.1	46.7
1934	221.0	309.0	328.0	22.0	44.0
1935	229.0	361.0	349.0	1.28	—21.3
Av., '34-'35	225.0	335.0	339.5	11.64	11.7
	Marketable Gains per Acre, Pounds.				
1931	69.4	69.4			
1932	174.2	231.6			
1933	148.6	264.8	174.9	29.5	53.1
Av., '32-'33	161.4	248.2	174.9	29.5	53.1
1934	156.0	193.0	214.0	20.0	38.0
1935	146.0	212.4	224.4	3.8	—10.7
Av., '34-'35	151.0	202.5	219.2	11.9	13.7

Although the figures in this table are not comparable, due to the fact that in the first three years' work the lots I and II animals were either steers or heifers, while in the other lots and the two remaining years the animals used were cows and calves, ewes and lambs, or both, yet the figures do indicate the progressive increased productive capacity of lot III. In 1933 this pasture produced 204.5 pounds of gain; in 1934, 328 pounds of gain; and in 1935, 349 pounds of gain. The figures for marketable gains show a similar progressive increase in carrying capacity.

Another rather remarkable feature of this experiment is the long time effect of discing and seeding. At the close of this experiment, which was four seasons after the discing and seeding, the lot II pasture was still producing 57 per cent more total gains than lot I. At this time, lot III, which had not been improved but which was grazed with cattle and sheep, produced 52 per cent more total gains than lot I.

The results shown in this table indicated the futility of attempting to utilize riverfront pasture with sheep alone. Sheep, when grazed by themselves, do not make enough gains to be economical producers. Yet as indicated above, cattle and sheep together make a very good combination.

The initial weights, final weights, gains per individual, and marketable gains per acre of calves and lambs are summarized in table VI.

TABLE VI. Summary of Weights and Gains of Calves and Lambs.

Lot	I	II	III		IV	V
			1934			
		Calves			Lambs	
Initial weight, lbs.	109	107	101	15	13	15
Final weight, lbs.	384	380	415	65	44	45
Gain, pounds	275	273	314	50	31	30
Gain per acre	156	193	184	30	20	38
			214			
			1935			
Initial weight, lbs.	123	120	125	23	23	24
Final weight, lbs.	398	419	477	61	42	49
Gain, pounds	275	299	353	38	19	25
Gain per acre	147	212	207	17	3.8	—10.7
			224			
	Average, 1934-1935.					
Initial weight, lbs.	116	114	113	19	18	20
Final weight, lbs.	387	400	446	63	43	47
Gain, pounds	275	286	339	56	25	28
Gain per acre	151	203	196	24	12	14
			220			

This table shows that the calves of lot II averaged heavier at weaning time than the calves of lot I, indicating a better pasture. The lot III calves averaged heavier than either the lot I or lot II calves, indicating better grazing in this pasture than in either of the other two pastures. Any pasture that produces 220 pounds of marketable gains to the acre and calves weighing 446 pounds at weaning time should be considered a good pasture.

Monthly Weights

The monthly weights of the cattle and sheep reflect to some extent the conditions of the pastures. The weights for 1934 are shown in table VII.

TABLE VII. Average Monthly Weights of Cows, Calves, Ewes, Lambs—1934.

Lot	I		II		III				IV		V	
Area, Acres	11.25		11.25		17.00				7.83		10.98	
Date	Cow lbs.	Calf lbs.	Cow lbs.	Calf lbs.	Cow lbs.	Calf lbs.	Ewe lbs.	Lamb lbs.	Ewe lbs.	Lamb lbs.	Ewe lbs.	Lamb lbs.
March 26	720	109	742	107	754	101	84.9	33.3	68.3	20.0	65.2	25.0
April 24	787	174	807	183	837	165	87.1	42.3	69.2	26.6	71.9	29.6
May 28	812	211	878	218	857	213	78.9	56.3	70.3	38.0	70.3	40.6
June 22	852	267	911	287	904	276	83.3	59.9	72.8	42.4	73.9	40.0
July 20	836	301	878	310	889	310	85.8	63.6	72.0	42.4	75.0	44.0
Aug. 19	819	331	848	333	875	345	90.5	64.7	72.8	41.2	76.4	43.1
Sept. 14	832	355	889	372	913	393	88.9	63.4	69.5	38.3	75.1	41.3
Oct. 13	841	385	886	381	916	420	91.8	64.0	75.1	40.0	75.1	41.7
Oct. 25	843	384	878	380	914	415	97.2	65.6	75.2	43.7	79.7	44.8
Gain, lbs.	123	275	136	273	160	314	17.6	50.9	2.5	31.1	10.1	29.5
Gain per acre, lbs.	65	156	116	193	94	185	19.0	30.0	2.0	20.0	6.0	38.0
Marketable gain per acre		156		193			215			20		38
Total gain per acre, lbs.		221		309			328			22		44

A study of this table shows that on July 20 there was little difference in the weight of the calves, but from this date to October 13, the lot III calves made considerably more gain than did the calves in the other two lots. However, after October 13 the calves in all three lots and the cows in lots II and III lost weight, indicating that the calves should have been sold about the middle of October for maximum returns.

The sheep did not respond to these grazing conditions the same as the cattle. On July 20 the lambs had reached near maximum weight and gained very little after this date. From July 20 to September 13 both the ewes and lambs were at a virtual standstill, but during the last six weeks period, from September 14 to October 25, there was some increase in weight of both ewes and lambs, indicating that the heat may have had something to do with the way sheep, especially lambs, gain during the summer months. The average monthly gains for 1935 are shown in table VIII.

TABLE VIII. Average Monthly Weights of Cows, Calves, Ewes, and Lambs. For the Grazing Season, 1935.

Lot	I		II		III				IV		V	
Area, Acres	11.25		11.25		17.00				7.83		10.98	
Date	Cow lbs.	Calf lbs.	Cow lbs.	Calf lbs.	Cow lbs.	Calf lbs.	Ewe lbs.	Lamb lbs.	Ewe lbs.	Lamb lbs.	Ewe lbs.	Lamb lbs.
March 28	725	123	717	120	768	125	72	23	71	23	69	24
April 25	792	163	816	161	847	177	80	30	70	27	69	23
May 24	814	202	849	202	887	228	81	42	70	37	73	34
June 20	827	235	868	244	916	274	81	48	66	38	67	32
July 18	817	283	843	278	895	332	88	55	70	41	66	34
Aug. 15	849	338	866	328	913	385	90	57	70	41	66	38
Sept. 13	860	370	914	374	956	438	90	58	68	42	66	42
Oct. 11	885	412	907	401	974	472	90	58	66	37	67	43
Oct. 30	880	398	926	419	956	477	92	61	68	42	70	49
Gain per acre, lbs.	83	147	149	212	111	207	14	17	—3	4	—11	—11
Marketable gain per acre, lbs.		147		212			224			4		—11
Total gain per acre, lbs.		229		361			349			1		—22

Again the cattle weights indicate that lot I had reached its maximum production by October 11, but not lots II and III. Both of these lots continued to show increased gains until October 30. The lambs in lots III, IV, and V gained slowly after July 18, indicating that heat and summer parasites may have influenced these gains. These two tables indicate a general tendency towards

Figure 3—Grazing sheep alone on riverfront pastures results in poor pasture utilization, heavy death losses, and light weight lambs.

low gains during July and August, with an increase in gains during September and the first half of October. Good pastures may continue to produce gains until November, but the productive pasture period certainly does not extend far past this date.

PARASITIC STUDIES

Parasitic studies were carried on along with the grazing, first with sheep and later with cattle. The Mississippi station (50) had recommended drenching lambs regularly every two weeks during the growing season of the lambs in order to produce strong healthy lambs. The Louisiana station adopted this practice as standard and started an experiment in which part of the lambs were undrenched, a part drenched with a one per cent solution of bluestone (copper sulphate), and a third group drenched with a solution containing one per cent bluestone and one per cent Blackleaf 40 (nicotine sulphate).

Lamb Drenching Studies, 1932

The first drenching trial of this series was started on July 25, 1932. On this date 39 lambs were divided into three groups of thirteen each and marked for identification. After this date all lambs were handled as one group and received the same care with these exceptions: lot I received no stomach worm drench; lot II was drenched regularly every two weeks with a one per cent solution of bluestone; lot III was drenched regularly every two weeks with a solution containing one per cent of bluestone plus one per cent of copper sulphate. The rate at which the drenches were administered in lots II and III was 1.2 cubic centimeters for each pound live weight. In order to increase gains, it was thought advisable to supplement the pasture with grain.

The records of weight, gains, and feed consumption are summarized in table IX.

TABLE IX. Effect of Drench Upon the Weight of Lambs.
July 22 to October 20, 1932—90 days.

Lot	I	II	III
Lambs	13	13	13
Drench	None	Bluestone	Bluestone + Blackleaf 40
Period	90	90	90
Average Initial weight, lbs.	65	65	65
Average Final weight, lbs.	65	66	64
Average Gain, lbs.	0	1	—1
Average Daily Ration:			
Corn, grain whole ear	.62	.62	.62
Cottonseed meal	.15	.15	.15

Drench had no effect upon the live weight of these lambs. Incidentally, the lambs did not gain during this period, even though they were fed .77 pounds of feed in addition to good pasture. This was somewhat surprising, although subsequent results indicate that summer gains in lambs are frequently non-existent.

In order to get some indication of the effect of the drench upon internal parasites, samples of feces were obtained at random from four lambs in each

of the three groups and examined for parasitic eggs. Fecal samples were taken on September 9, October 6, and October 20. The results of these examinations are found in table X.

TABLE X. Effect of Drench Upon Nematode Eggs Found in Feces of Lambs—1932.

Lot	I			II			III		
Drench	None			Bluestone			Bluestone plus Blackleaf 40		
Date	Sept. 9	Oct. 6	Oct. 20	Sept. 9	Oct. 6	Oct. 20	Sept. 9	Oct. 6	Oct. 20
Sample 1	11	34	73	4	13	12	3	0	0
Sample 2	97	7	21	5	8	6	7	9	6
Sample 3	12	9	15	3	2	3	9	11	28
Sample 4	44	99	155	Lost	146	84	2	12	12
Total	164	149	264	12	169	105	21	37	46
Average	41	37	66	4	42	26	5	9	11
Lot total	577			286			104		
Lot average	48			26			9		

Drenching reduced the average fecal egg count of the lambs in lots II and III. When taken as a lot average, the differences in fecal egg counts were quite marked, lot I being 48; lot II, 26; and lot III, 9.

Post Mortem Examination—1932

At the close of the grazing period, four lambs were picked at random, slaughtered, and their intestinal tracts examined for internal parasites. The results of this examination are summarized in table XI.

TABLE XI. Parasites Found in the Stomach and Intestines of Lambs—1932.

Lamb No.	Date Slaughtered	—Stomach Worm— Stomach	Small Intestine	Nodular Worm	Coccidia
	Lot I—No Drench				
125	November 1	+	—	+++	+
117	November 9	+	—	++	+
120	November 18	+	—	++	+
114	December 2	+++	++	+	++
	Lot II—Bluestone Drench				
172	November 1	+	—	++	+
101	November 9	+	—	+++	+++
105	November 18	+	+	++	+++
102	December 2	+	+	+	++
	Lot III—Bluestone-Blackleaf 40 Drench				
119	November 1	+	—	++++	+
116	November 9	+	+	++	+
113	November 18	+	—	++	+
108	December 2	+	—	+++	++

The most outstanding point brought out by these post mortem examinations is the relatively high infestation of nodular worms in all three lots. These thirty-nine lambs had been grazed on an eight acre pasture. This relatively intense grazing may account for the heavy infestation of nodular worms. Drench apparently had little effect upon stomach worm infestation.

Lamb Drenching Studies, 1933

The procedure on the lamb drenching studies was changed in 1933, as compared to 1932. In 1933 the lambs were grazed with their mothers throughout the grazing period and received no supplemental feed. Drenching was started on April 10 and continued until the close of the experiment on October 12, or a period of 185 days.

In this trial, thirty-one lambs were divided into three groups as follows: lot I, eleven lambs; lot II, eight lambs; and lot III, twelve lambs. As in the preceding year, the lot I lambs were undrenched, the lot II lambs were drenched with 1.2 cubic centimeters of a one per cent bluestone solution per pound live weight every fourteen days, while the lambs in lot III received a similar amount of a solution containing one per cent bluestone and one per cent Blackleaf 40. All three groups were grazed together on the same pastures. All ewes were drenched with the bluestone-Blackleaf 40 drench, and, as in all our drenching work, both the ewes and lambs were penned without feed for eighteen hours before drenching. The effect of the drench upon the liveweight of the lambs is shown in table XII.

TABLE XII. Summary of Weights and Gains of Lambs, 1933.

Lot		I		II		III	
Drench		None		Bluestone		Bluestone & Blackleaf 40	
No. lambs in lot		11		8		13	
Date	Period (days)	Weight lbs.	Gain lbs.	Weight lbs.	Gain lbs.	Weight lbs.	Gain lbs.
April 10	0	35.5	----	34.1	----	34.1	----
May 8	28	44.5	9.0	43.2	9.1	43.9	9.8
June 5	28	50.7	6.2	50.2	7.0	49.7	5.8
July 3	28	56.5	5.8	54.5	4.3	56.2	6.5
July 31	28	62.4	5.9	58.6	4.1	60.7	4.5
August 28*	28	58.0	—4.4	54.7	—3.9	58.6	—2.1
Sept. 25	28	59.2	1.2	56.2	1.5	58.8	.2
October 12	17	59.2	0	56.2	0	59.1	.3
Total gain			23.7		22.1		25.0

*The lambs were shorn during this 28-day period, which accounts for a part of this loss in weight.

Again drench had no effect upon weight or gain in weight of these lambs. The undrenched lambs made just as good gains as those drenched, and the small difference in the gains of the lot II and lot III lambs cannot be considered significant, consequently the conclusion that drench had no effect upon gains is valid. As in the previous year, the lambs made little or no gain after July. Fecal egg counts and post mortem examinations were made, as in the previous year. These figures are summarized in table XIII.

TABLE XIII. Fecal Egg Counts and Post Mortem Examinations of Lambs, 1933.

Lamb No.	Fecal Egg Counts Aug. 12	Fecal Egg Counts Oct. 6	Post Mortem Examination — Stomach — Stomach Worm	Stomach — Nodular	Intestine — Hook	Intestine — Cooperia	Intestine — Tape
			Lot I. No Drench.				
400			—	—	+	+++	
411		129					
343		108	+	+	—	++	10 immature
395	46						
348	46	44					
349	166	277	++++	—	—	+	
352	6		+	+	—	++	
356		198	+	—	—	+	
367			+++	—	—	—	
374			+	+	—	—	
377			—	+	—	—	
Total	264	756					
Average	66	151					
Lot total	1020						
Lot average	113						
			Lot II. Bluestone Drench.				
403		75					
405		66					
404		61	—	+	—	+	
346	112	26	—	—	—	+++	
350	3	0					
353		362					
359	239						
375		203					
Total	354	793					
Average	118	113					
Lot total	1147						
Lot average	115						
			Lot III. Bluestone-Blackleaf 40 Drench.				
402		82	+	—	—	+	
405			+	—	—	—	
407		5	—	—	++	+	
341	6	200					
342	65		+	+	—	—	
344	4						
351			+	—	—	+	
357		3					
360	1		—	—	—	—	
363			—	+	—	—	
368			—	+++	+	—	
370		59	+	—	—	—	
Total	76	349					
Average	19	70					
Lot total	425						
Lot average	47						

Although there were quite wide variations, the bluestone-blackleaf 40 drench seems to have reduced the fecal egg counts in lot III to a rather low count; 47 eggs to the slide as compared to 115 and 113 eggs per slide for lots II and I, respectively. The post mortem examinations indicate that both blue-

stone and the bluestone-Blackleaf 40 solution were effective in reducing the number of stomach worms. This is particularly noticeable in lot III, where nine lambs were examined and none was heavily infested with stomach worms.

Lamb Drenching Studies, 1934

The 1934 lamb drenching studies were carried out under the same procedure as in 1933. Twenty-nine lambs were divided into three lots—ten lambs in lot I, ten in lot II, and nine lambs in lot III. The lot I lambs received no drench. The lot II lambs were drenched with bluestone, and the lot III lambs with the bluestone-Blackleaf 40. The rate of drenching was 1.2 cubic centimeters, as in the preceding years. The ewes were drenched with bluestone-Blackleaf 40. All three groups were grazed together on the same pastures. Drenching was started on March 28 and continued to October 25, 1934, a period of 210 days. The effect of the drench upon the gains in liveweight of the lambs is shown in table XIV.

TABLE XIV. Effect of Drench Upon the Weights and Gains of Lambs, 1934. March 28 to October 25—210 days.

Lot		I		II		III	
Drench		None		Bluestone		Bluestone & Blackleaf 40	
Lambs in lot		10		10		9	
Date	Period (days)	Weight lbs.	Gain lbs.	Weight lbs.	Gain lbs.	Weight lbs.	Gain lbs.
March 28	0	33.9	----	33.8	----	32.3	----
April 25	28	41.9	8.0	41.9	8.1	40.6	8.3
May 23	28	45.4	3.5	45.7	3.8	44.3	3.7
June 20	28	49.1	3.7	49.5	3.8	48.3	4.0
July 18	28	52.2	3.1	50.3	.8	49.8	1.5
August 15	28	51.3	— .9	50.1	—.2	48.9	—.9
Sept. 12	28	49.5	—1.8	48.6	—1.5	47.2	—1.7
October 10	28	46.4	—3.1	48.0	—.6	42.5	—4.7
October 25	14	53.1	6.7	51.5	3.5	48.8	6.3
Total gain			19.2		17.7		16.5

Again there was no effect of drench upon the liveweights or gains in liveweight. And again the lambs failed to gain after July, until October 10. Drenching may have a beneficial effect, due to its reducing the number of parasites, but this beneficial effect, if any, was fully offset by the drench itself insofar as gains in liveweight are concerned. This is shown rather forcibly by the final weights and gains in weight of the lambs. These figures and their straight averages are shown in table XV. Drench had no effect either on the final weight or on the gain in weight of the lambs.

TABLE XV. Effect of Drench Upon Average Final Weights and Gains in Weight of Lambs, 1933-1934.

Lot	I	II	III
Average final weight—1933	59.2	50.2	59.1
—1934	53.1	51.5	48.8
Average	56.1	50.9	53.9
Average gain in pounds—1933	23.7	22.1	25.0
—1934	19.2	17.7	16.5
Average	21.5	19.9	20.8

The fecal egg counts and the results of the post mortem examination are shown in table XVI.

TABLE XVI. Fecal Egg Counts and Post Mortem Examination of Lambs, 1934.

Lamb No.	Nematode Eggs April 10	May 25	July 19	Sept. 13	Post Mortem Examination Stomach Worm	Whip Worm	Nodular Worm
Lot I. No Drench.							
418	7	5	17		+	—	++++
430	0	402	8	0	—	+	+
417	2	79	24	4	—	—	+++
427	79	155	411	115	—	—	+++
441	288	6	3		—	+	+
424	64	2000	30	305	+	+	++++
426	4	114	41	30	—	+	+++
436	101	1	7	41	—	+	+
419	13	1	0	2	+	+++	+
438	1	5	21	4	+	—	+
Total	559	2768	562	501			
Average	56	277	56	63			
Lot total	4390						
Lot average	116						
Lot II. Bluestone Drench.							
431	9	142	15	3	+	+	+++
416	28	37	77	52	+	+	+++
428		89	400		—	+	+
415	36	230	5	93	—	—	++++
420	19	124		8	—	+	++++
443	25	3	500	543	—	+	++++
413	7	280	5	0			
433	255	10	6		+	—	+
414		2	7	1	+	—	+
449		16	5	1	+	++	+
Total	379	933	1020	701			
Average	54	93	113	88			
Lot total	3033						
Lot average	89						
Lot III. Bluestone-Blackleaf 40 Drench.							
442	71	101	600	49	—	+	++
434	167	440	117	30	—	+	+
437	26	32	4	26	—	—	+++
423		20			—	+	+++
447	44	700	16	283	—	+	+++
422	7	436		27	+	—	++
421	39	50	0				
440	132	100	45	13	—	—	++++
429		5	4	0	+	+	+
Total	486	1884	786	428			
Average	69	209	112	61			
Lot total	3584						
Lot average	119.5						

This table has some very interesting features. For example, on April 10, an average of all slides showed 59 nematode eggs per slide; on May 25, 206 eggs; on July 19, 91 eggs; and on September 13, 70 eggs. Is there any significance in these seasonal variations? If there is, then May appears to be the month in which lambs are most likely to become heavily infested with stomach worms. The light infestation in the subsequent months might indicate two things: (1) that sheep tend to rid themselves of internal parasites, and (2) that the hot, somewhat dry months of the summer and early fall are less favorable to parasitic infestation than is the spring. In lot I, lamb No. 424, for example, showed a high fecal egg count (2000) in May, but in July his fecal egg count was only 30. In this same lot, lamb No. 430 showed a fecal egg count of 402 in May, but only 8 in July. However, it may be that these fecal egg counts are not reliable indicators of parasitic infestation. This point will be discussed later.

Another rather interesting feature about this chart is the fact that on post mortem examination fourteen out of the twenty-nine lambs showed heavy infestations of nodular worms, two showed moderate infestations, and the remainder light infestation. From this it appears that nodular worms may be just as important as stomach worms, especially where sheep are pastured rather heavily on the same ground year after year.

There was some indication that drenching had some effect on the production of nematode eggs, but this effect was not consistent. The average egg counts by lots are shown in table XVII.

TABLE XVII. Nematode Eggs to the Slide by Lots and Years.

Lot	I	II	III
Drench	None	Bluestone	Bluestone-Blackleaf 40
	Eggs Per Slide		
Year:			
1932	48	26	9
1933	113	115	47
1934	116	89	120

From these figures one might question either (a) the effectiveness of these drenches or (b) the value of fecal egg counts as an indicator of stomach worm infestation. In this connection, it must be kept in mind that, particularly in 1934, most of the lambs in each of the three lots were heavily infested with nodular worms. Hence, it seems reasonable to believe that drench might be effective in controlling stomach worms, but not nodular worms, and that a count of nematode eggs would not be an indicator of the effectiveness of the drench unless a differentiation were made between the eggs of the various round worms. Such a differentiation is difficult to make.

GRAZING AS A METHOD OF CONTROLLING INTERNAL PARASITES IN LAMBS

The grazing and parasitic studies previously discussed were so arranged that the effect of grazing systems upon parasitic infestation could be studied. The effect of grazing systems upon the parasitic infestation of lambs will be discussed first. As was pointed out earlier in this bulletin, lot III, an unim-

TABLE XVIII. Fecal Egg Counts and Post Mortem Examination of Lambs as Affected by Grazing Systems, 1933.

Lamb No.	Fecal Egg Counts August 12	Fecal Egg Counts October 6	Post Mortem Examination — Stomach — Stomach Worm	Stomach — Nodular Worm	Intestine — Hook Worm	Intestine — Cooperia
Lot III. Cows, Calves, Ewes, Lambs.						
400			—	—	+	+++
402		82	+	—	—	—
403		75				
404		61	—	—	—	+
405		66				
407		5	—	—	++	+
411		129				
Total		418				
Average		70				
Lot IV. Ewes and Lambs, Unimproved Pasture.						
342	65		+	+	—	—
344	4					
348	46	44				
349	166	277	++++	—	—	+
350	3	0				
357		3				
359	239					
375		203				
405		66				
Total	523	593				
Average	87	99				
Lot total	1116					
Lot average	93					
Lot V. Ewes and Lambs, Improved Pasture, Rotated Weekly.						
341	6	200				
343		108	+	+	—	++
345	46					
346	112	26	—	—	—	+++
351			+	—	—	+
352	6		+	++	—	++
353		362				
356		198	+	—	—	+
360	1		—	—	—	—
363			—	+	—	—
367			+++	—	—	—
368			—	+++	+	—
370		59	+	—	—	—
374			+	+	—	—
377			—	+	—	—
Total	230	894				
Average	38	79				
Lot total	1124					
Lot average	102					

TABLE XIX. Fecal Egg Counts and Post Mortem Examinations of Lambs as Affected by Grazing Systems, 1934.

Lamb No.	Fecal Egg Counts April 10	May 25	July 19	Sept. 13	Post Mortem Examination Stomach Worms	Whip Worms	Nodular Worms
Lot III. Cows, Calves, Ewes, and Lambs—Unimproved Pasture.							
413	7	280	5	0			
419	13	1	0	2	+	+++	+
421	39	50	0				
433	255	10	6		+	—	+
436	101	1	7	41	—	+	+
438	1	5	21	4	+	—	+
441	288	6	3		—	+	+
429		5	4	0	+	+	+
414		2	7	1	+	—	+
449		16	5	1	+	++	+
Total	705	377	58	49			
Average	88	38	6	7			
Lot total		1189					
Lot average		54					
Lot IV. Ewes and Lambs, Unimproved Pasture.							
417	2	79	24	4	—	—	+++
418	7	5	17		+	—	++++
430	0	402	8	0	—	+	+
431	9	142	15	3	+	+	+++
442	71	101	600	49	—	+	++
Total	89	729	664	56			
Average	22	146	133	14			
Lot total		1538					
Lot average		81					
Lot V. Ewes and Lambs, Improved Pasture.							
415	36	230	5	93	—	—	++++
416	28	37	77	52	+	+	+++
420	19	124		8	—	+	+++
422	7	436		27	+	—	++
424	64	2000	30	305	+	+	++++
426	4	114	41	30	—	+	+++
427	79	155	411	115	—	—	+++
428		89	400		—	+	+
434	167	440	17	30	—	+	+
437	26	32	4	26	—	—	+++
440	132	100	45	13	—	—	++++
443	25	3	500	543	—	+	+++
447	44	700	16	283	—	+	+++
423		20			—	+	+++
Total	665	4480	1546	1525			
Average	51	320	131	127			
Lot total		8216					
Lot average		168					

TABLE XX. Fecal Egg Counts and Post Mortem Examinations of Lambs as Affected by Grazing Systems, 1935.

Lamb No.	Fecal Egg Counts April 22	June 10	Sept. 3	Post Mortem Examination — Stomach Stomach Worm	Small Intestine Hook worm	Nod. worm	Tape worm	Lg. Intest. Whip worm	Nod. worm	Head Bots
Lot III. Cows, Calves, Ewes, and Lambs on Unimproved Pasture.										
500	1	43	21	+	+	—	—	—	+	—
508	244	20	80	—	+	+	—	+	+	—
525	23	115	110	+	+	—	—	+	+++	—
527	185	27	90	++	—	—	—	+	+	—
528	69	6	47	+	—	—	—	+++	++	—
600	31	48	90	—	—	+	—	—	++	—
504	124	23	88	+	—	—	—	+	++	2
Total	577	282	526							
Average	82	40	75							
Lot total		1385								
Lot average		66								
Lot IV. Ewes and Lambs on Unimproved Pasture.										
502	12	62	90	++++	+	—	—	—	—	—
506	175	106		++++	+	—	—	—	++	2
514	198	27	200	+++	—	++	—	+	++	—
720	62	90	199	+++	+	—	—	+	+	—
526	32	421		Died August 18, 1935						
529	4	15	90	++++	+	—	+	—	+++	*10/11
Total	483	721	579							
Average	81	121	145							
Lot total		1783								
Lot average		111								
Lot V. Ewes and Lambs on Improved Pasture.										
501	80	202		Died September 13, 1935.						
503		92		++++	+	—	—	+	++	* 7/25
510	180			Died June 20, 1935.						
517	198	103	99	+	+	+	—	++	++	—
516	230	30		Died August 17, 1935.						
521	195	214		Died July 18, 1935.						
735	199	792	0	—	—	—	—	—	++	*10/11
531	64	541		Died August 19, 1935.						
532	7	1043		Died July 18, 1935.						
Total	1155	3017	99							
Average	144	377	50							
Lot total		4271								
Lot average		237								

*Killed on date given.

proved pasture, was grazed with cows, calves, ewes, and lambs; lot IV, an unimproved pasture, was grazed with ewes and lambs; and lot V, an improved pasture, was grazed with ewes and lambs. Lot V was divided into four pastures and the ewes and lambs rotated weekly. In this way, the sheep were on a new pasture each week. It was thought that such a system would permit the clover to reseed itself and perhaps produce a better pasture. Such a system, however, meant a rather heavy concentration of sheep on a small area

of ground at all times. This heavy concentration may account for some of the differences in parasitic infestation. The results of the fecal egg counts and post mortem examination of the lambs for the year 1933 are shown in table XVIII.

This table shows the lot III lambs which were grazed with cattle to have fewer nematode eggs in their feces than the lambs of lot IV, and the lambs of lot IV to have fewer eggs in their feces than those of lot V. The heavier concentraton of sheep on a small area of land may have accounted for the higher nematode egg counts of the feces of the lambs in this last lot. It is also rather interesting to note from the post mortem examinations that one of the two lambs examined in lot IV had a heavy infestation of stomach worms, and that several of the lambs in lot V were infested with cooperia. Table XIX shows the results of the fecal egg counts and post mortem examinations of the lambs for 1934.

Again the lot III lambs had fewer nematode eggs in their feces than did the lot IV lambs, and the lot IV lambs had fewer than the lot V lambs. The post mortem examinations showed the lot III lambs to be comparatively free from nodular worms, while the lot IV and V lambs were relatively heavily infested with nodular worms. Evidently grazing sheep with cattle resulted in a marked reduction in nodular worms. We believe this reduction to be due to (1) fewer sheep to an acre of land, and (2) the closer grazing of the coarse grasses by the cattle thereby reducing the shade on and the moisture in the soil.

The procedure was changed slightly in 1935. In the previous years, two lambs out of three in each lot were drenched, the third lamb was undrenched. Drenching, as shown in the drenching studies, had failed to produce heavier lambs at market time than no drenching. The undrenched lambs had averaged just as heavy in October as the drenched lambs. The ewes in all lots had been drenched regularly every 14 days. In 1935, all ewes and lambs were drenched at the time they were weighed into the lots, but neither the ewes nor the lambs were drenched after that, even though they became extremely emaciated from parasite infestation. Instead, they were killed and examined for parasites. In some cases, the lambs died and were not examined. The 1935 results are shown in table XX.

Again the lot III lambs had fewer nematode eggs in their feces than did the lot IV lambs, and the lot IV lambs had fewer than the lot V lambs. The lot III had relatively few stomach worms, few hook worms and nodular worms in the small intestine, but a medium infestation of nodular worms in the large intestine. The lot IV lambs were all heavily infested with stomach worms and carried moderate to heavy infestations of nodular worms. Two lambs out of this lot of six died, or were killed because of emaciated condition during the

course of the experiment. In lot V, only one lamb of the nine lived to the end of the experiment. This lamb showed only a slight infestation of internal parasites, which may have been due to natural resistance, grazing habits, or some other cause. These figures show that healthy, vigorous lambs can be raised without drenching, when grazed with cattle, but that heavy stocking of sheep on small areas of land is decidedly not economical.

TABLE XXI. Comparison of the Effects of Drench and Grazing Systems Upon the Final Weights and Fecal Egg Counts of Suckling Lambs*.

Lot	I	II	III
Lambs	21	18	21
Deaths	0	0	0
	Effects of Drench.		
Final Weights:	No Drench	Bluestone	Bluestone-Blackleaf
1933	59.2	56.2	59.1
1934	46.4	48.0	42.5
Average	52.8	52.1	50.8
Fecal Egg Counts:			
1933	113	115	47
1934	116	89	120
Average	115	102	84
	Effects of Grazing Systems.		
Lot	III	IV	V
Lambs	24	20	38
Deaths	0	1	8
Final Weights:			
1933	63	52	55
1934	65	44	45
1935	61	42	48
Average	63	46	49
Fecal Egg Counts:			
1933	70	93	102
1934	54	81	168
1935	66	111	237
Average	63	95	166

*The yearling lambs were not included in this comparison.

From these data it is quite apparent that grazing cattle and sheep together was more effective in producing heavy weight lambs than drench. Likewise, it is quite evident that, aside from low pasture production, internal parasites make the utilization of pasture by sheep alone a very hazardous enterprise.

EFFECT OF GRAZING CATTLE AND SHEEP TOGETHER UPON THE INTERNAL PARASITES OF CALVES

Many cattlemen and veterinarians in Louisiana have claimed that sheep and cattle cannot be grazed together because the calves become infested with stomach worms from the sheep. Data have already been presented showing the effect of grazing cattle and sheep together upon the live weight gains and production per acre of pastures grazed by cattle, cattle and sheep, and by sheep alone. Data concerning the parasitic infestation of calves grazed on cattle pastures and on cattle and sheep pastures will now be presented.

In 1933, post mortem examinations were made on the twelve calves in lot III and on twelve comparable calves in the regular cattle pasture, which were called lot VI. These data are presented in table XXII.

TABLE XXII. Parasitic Infestation of Calves Raised on Regular Cattle Pasture and on Cattle and Sheep Pasture.

Calf No.	—Post Mortem Examination— Stomach Worms	Hook Worms	Calf No.	—Post Mortem Examination— Stomach Worms	Hook Worms
Lot III. Cows, Calves, Ewes, Lambs.			Lot VI. Regular Cattle Pasture		
51	+	+	52	+++	++
267	+	—	56	+++	++
275	—	+	58		
276	++	+	57		
284	+	++	277		
285	+++	+	283	—	—
288	+	+	289	+	++
299	+	++	291	+	++
307	++	+	300	++	++
316	+	+	301	++	+
318			313		
320			310	++	++

These data do not show any indication of heavier infestation of stomach or hook worms in the calves as a result of grazing cattle and sheep together. In 1934, post mortem examinations were made on all calves in lots I, II, and III. The results of these examinations are shown in table XXIII.

TABLE XXIII. Results of Post Mortem Examination of Calves, 1934.

Calf	Stomach Worm	Hook Worm	Nodular Worm	Whip Worm
Lot I. Cows and Calves, Unimproved Pasture.				
361	+	—	+	—
386	++	+	++++	+
411	—	+	+++	+
395	—	—	+	—
379	+	—	+	—
400	—	+	+++	—
Lot II. Cows and Calves, Improved Pasture.				
402	—	—	+	+
404	—	++	+++	—
368	+	+	+	+
412	+	—	+++	—
366	+	—	++	—
393	++	+++	+++	—
390	++	+++	+++	+
355	+	++	+++	+
Lot III. Cows, Calves, Ewes, and Lambs, Unimproved Pasture.				
403	—	+++	+	—
405	+	+	—	—
408	—	—	+++	+++
371	+	+	+	—
378	—	+	+	—
385	+	+	+	—
384	—	—	+	+
399				
397	+	+	++	++
376				

From these data sheep could not be accused of giving the calves stomach worms, because the heavier infestations of stomach worms occurred in the other two lots. Likewise, the heavier infestations of hook worms and nodular worms occurred in the other two lots.

Parasitic studies of the three lots of calves were planned for 1935, but unfortunately, through a misunderstanding at the abattoir, no data were obtained on the lot I and II calves. Data were obtained, however, on the lot III calves, and on a group of eight calves from the regular cattle pasture. These data are presented in table XXIV.

TABLE XXIV. Parasitic Infestation of Calves Raised on Regular Cattle Pasture and on Sheep and Cattle Pasture.

	——Post Mortem Examination——					——Post Mortem Examination——			
Calf No.	Stomach Worm	Hook Worm	Nodular Worm	Whip Worm	Calf No.	Stomach Worm	Hook Worm	Nodular Worm	Whip Worm
Lot III. Cows, Calves, Ewes, Lambs.					Lot —. Regular Cattle Pasture.				
464	—	—	+	+	530	—	+	—	—
448	—	+	+	—	505	—	+	+	+
478	+	+	—	—	501	++	+	++	+
476	—	+	+	—	473	+	+	++	—
451	—	—	+	—	555	—	++	+	+
467					431	+	+	+	+
480	—	+	+	—	463	+	+	—	—
483					434	—	+	—	—
458	+	—	+	—					
470	—	—	+	—					

Again there is no evidence that grazing cattle and sheep on the same pasture increases parasitic infestation of the calves. On the contrary, grazing these two classes of animals together under the conditions of this experiment resulted in fewer parasites, in both calves and lambs. These results may have been due to (1) fewer animals of each type on an area of ground, or (2) the fact that cattle and sheep are not hosts to the same internal parasites, including the stomach worm.

FORAGE STUDIES

During the grazing seasons of 1934 and 1935 forage studies were made from protected and unprotected plats during the grazing season. Three of these plats were located in different areas of each lot and three cuttings of one meter square were taken at different seasons of the year—spring, summer, and fall. A third group of protected plats was left uncut until fall. Consequently, the forage on three groups of plats was studied as follows: (a) unprotected plats cut at three seasons of the year; (b) protected plats cut at three seasons of the year; and (c) protected plats cut in the fall. The studies of the unprotected plats are of considerable significance because they indicate the progressive effect of grazing different classes of animals. In this connection it should be kept in mind that these forage studies were not started at the same time the experiment was started, hence the differences in forages may be due in part to grazing previous to the time of the forage studies. The data for the unprotected plats for the year 1934 are shown in table XXV.

TABLE XXV. Forage Studies of Unprotected Grazed Plats, 1934.
(All figures in per cent.)

Lot	I	II	III	IV	V
June Cutting					
Dallis Grass	11.68	7.05	35.48	22.03	28.14
Bermuda Grass	47.19	51.76	8.78	44.59	37.11
Broom Sedge	-----	-----	-----	-----	-----
White Dutch Clover	.95	.42	10.81	.41	8.04
Weeds and Miscellaneous	40.18	40.77	44.93	32.97	26.71
August Cutting					
Dallis Grass	9.92	8.37	72.43	63.81	41.61
Bermuda Grass	56.57	69.94	14.70	30.78	47.86
Broom Sedge	-----	-----	1.40	-----	-----
White Dutch Clover	-----	-----	-----	-----	.25
Weeds and Miscellaneous	33.51	18.98	11.47	5.16	10.20
November Cutting					
Dallis Grass	8.88	4.68	53.94	42.03	28.50
Bermuda Grass	74.57	84.55	15.44	8.92	30.08
Broom Sedge	.41	-----	-----	18.77	8.64
White Dutch Clover	-----	.74	.32	-----	.11
Weeds and Miscellaneous	16.14	9.08	30.08	28.85	31.14
Average of all Cuttings.					
Dallis Grass	10.75	7.12	58.42	37.38	31.70
Bermuda Grass	53.89	64.05	13.23	34.00	38.64
Broom Sedge	.06	-----	-----	3.56	1.56
White Dutch Clover	.53	.32	3.76	.22	4.59
Weeds and Miscellaneous	34.77	27.36	24.54	24.50	23.22

Probably the most outstanding features of this table are (1) the predominance of Bermuda grass in lots I and II, (2) the high percentage of Dallis grass in lot III, and (3) the broom sedge showing up in lots IV and V. These differences were most pronounced in the fall and could be seen by walking through the pastures. The data for the unprotected plats for 1935 are shown in table XXVI.

TABLE XXVI. Forage Studies of Unprotected Grazed Plats, 1935.
(All figures in per cent.)

Lot	I	II	III	IV	V
		June Cutting.			
Dallis grass	6.16	2.05	28.07	8.83	18.02
Bermuda grass	20.16	19.62	23.77	42.64	41.55
Broom sedge	.18	-----	-----	30.74	10.58
White Dutch clover	1.00	18.03	20.18	-----	5.66
Weeds	5.80	11.90	4.10	.60	2.50
		August Cutting.			
Dallis grass	2.67	9.71	30.80	.02	26.10
Bermuda grass	25.50	58.30	3.30	2.00	19.12
Broom sedge	.10	-----	.10	76.50	24.10
White Dutch clover	.03	.22	.33	-----	.32
Weeds	32.70	11.70	.27	.05	2.20
		November Cutting.			
Dallis grass	2.60	3.10	55.80	4.60	52.30
Bermuda grass	36.60	39.00	28.70	3.90	3.60
Broom sedge	-----	-----	-----	80.00	21.00
White Dutch clover	-----	-----	-----	-----	-----
Weeds	17.20	9.10	.80	.20	1.90
		Average of All Cuttings.			
Dallis grass	3.40	6.90	36.10	2.00	37.70
Bermuda grass	27.60	47.70	14.20	10.40	20.00
Broom sedge	1.10	-----	-----	68.80	19.90
White Dutch clover	.20	2.70	6.00	-----	1.50
Weeds	17.10	9.20	.80	.20	2.00

Again, as in table XXV, the most outstanding differences shown by this table are the predominance of Bermuda grass in lots I and II, the preponderance of Dallis grass in lot III, and the high percentages of broom sedge in lots IV and V.

Another difference which tables XXV and XXVI do not bring out is the fact that lots I, II, and III were grazed rather close, while lots IV and V had a heavy growth of coarse grass which the sheep would not eat. All five lots were mowed at the end of the grazing period, but only lots IV and V had enough material to rake. The figures for 1934 and 1935 are shown in table XXVII.

TABLE XXVII. Forage Produced in Excess of Grazing (Mostly Coarse Grasses).

Lot	I	II	III	IV	V
1934, pounds	0	0	0	7.930	26.345
1935, pounds	0	0	0	40.585	32.065

These figures give some idea of the amount of forage on a riverfront pasture which is not utilized by grazing with sheep alone. This large amount of forage which is not utilized makes it unprofitable to graze riverfront pastures with sheep alone. Parasitic infestation makes it impractical to put enough sheep on these pastures to keep the forage grazed down to the point where the forage is green and tender. A combination of cattle and sheep proved most effective from the standpoint of both pasture utilization and parasitic infestation.

The data obtained from the forage studies of the protected plats are shown in tables XXVIII, XXIX, XXX, and XXXI. The average chemical composition of the pasture plants found in the experimental plots in the October, 1935, cutting is shown in table XXXII.

Figure 4—Sheep do not utilize coarse pasture grasses.

Figure 5—Grazing sheep and cattle together results in good grazing and few weeds.

TABLE XXVIII. Forage Studies of Protected Ungrazed Plats, 1934.
(All Figures in Per Cent.)

	Lot I	Lot II	Lot III	Lot IV	Lot V
June Cutting.					
Dallis grass	11.05	11.80	53.87	45.90	21.35
Bermuda grass	21.58	41.84	2.86	18.03	22.54
Broom sedge	-----	-----	-----	-----	-----
White Dutch clover	1.65	-----	29.74	.13	31.47
Weeds	-----	-----	-----	-----	-----
August Cutting.					
Dallis grass	39.29	24.77	90.58	67.39	70.03
Bermuda grass	39.72	29.24	1.50	17.48	20.73
Broom sedge	-----	-----	-----	-----	-----
White Dutch clover	-----	-----	.33	-----	2.90
Weeds	-----	-----	-----	-----	-----
November Cutting.					
Dallis grass	28.43	7.14	86.56	21.75	48.76
Bermuda grass	33.22	47.84	1.33	11.12	13.09
Broom sedge	10.91	-----	-----	41.41	17.36
White Dutch clover	-----	-----	-----	-----	-----
Weeds	2.06	13.23	.07	.55	-----
Average of All Cuttings.					
Dallis grass	26.07	14.81	77.02	47.22	42.83
Bermuda grass	31.39	37.65	1.93	15.62	20.02
Broom sedge	3.42	-----	-----	13.08	3.53
White Dutch clover	.57	-----	10.41	.03	15.73
Weeds	.65	4.65	.01	-----	.11

TABLE XXIX. Forage Studies of Protected Ungrazed Plats, 1935.
(All Figures in Per Cent.)

	Lot I	Lot II	Lot III	Lot IV	Lot V
June Cutting.					
Dallis grass	19.19	5.08	64.06	19.52	34.61
Bermuda grass	8.48	12.55	.41	3.37	4.81
Broom sedge	1.55	-----	.21	41.11	3.22
White Dutch clover	30.54	28.69	11.35	5.21	37.98
Weeds	26.10	41.85	11.38	12.35	13.32
August Cutting.					
Dallis grass	46.38	41.95	91.28	30.28	47.50
Bermuda grass	14.01	12.25	.78	2.17	12.55
Broom sedge	2.20	-----	-----	60.96	.18
White Dutch clover	.21	.32	.68	.25	.48
Weeds	30.91	7.01	4.10	.89	1.26
November Cutting.					
Dallis grass	56.91	10.54	88.20	7.64	43.88
Bermuda grass	15.65	47.86	1.11	1.78	11.96
Broom sedge	13.45	-----	-----	76.61	17.71
White Dutch clover	-----	.11	.08	-----	-----
Weeds	4.84	.44	4.29	.27	.87
Average of All Cuttings.					
Dallis grass	43.76	22.59	84.34	20.90	40.14
Bermuda grass	12.52	14.72	.75	2.79	8.25
Broom sedge	3.85	-----	.08	52.07	3.22
White Dutch clover	.07	13.64	.32	3.01	21.01
Weeds	26.98	23.36	7.37	7.65	8.23

TABLE XXX. Forage Studies—Protected, Nine Months Growth, 1934.
(All Figures in Per Cent.)

	Lot I	Lot II	Lot III	Lot IV	Lot V
Dallis grass	23.93	29.41	48.25	1.21	4.98
Bermuda grass	25.78	22.37	.09	3.71	33.13
Broom sedge	3.46	-----	1.50	79.60	8.90
White Dutch clover	-----	.43	-----	-----	.01
Weeds	42.20	30.10	37.19	15.08	34.56

Figure 6—Weeds are found in pastures grazed exclusively by cattle.

TABLE XXXI. Forage Studies—Protected, Nine Months' Growth, 1935.
(All Figures in Per Cent.)

	Lot I	Lot II	Lot III	Lot IV	Lot V
Dallis grass	5.34	2.73	34.00	5.30	39.95
Bermuda grass	1.64	2.00	5.05	.75	12.49
Broom sedge	4.24	-----	5.76	37.30	.37
White Dutch clover	-----	-----	-----	-----	-----
Weeds	67.97	23.43	46.97	30.52	15.95

TABLE XXXII. Average Chemical Analyses of Pasture Plants Cut in October, 1935.

Plant	Protein	Ether Extract	N.F.E.	Fiber	Ash	CaO	P_2O_5
Pasaplum	4.60	1.15	44.69	34.66	7.72	.478	.368
Coco grass	6.63	1.87	49.34	26.38	9.03	.209	.233
Bermuda	5.25	1.20	48.43	31.00	6.94	.412	.401
Sedge grass	3.49	1.36	43.52	39.74	4.31	.226	.241
Foxtail Meadow grass	3.63	1.33	41.48	37.77	8.52	.518	.397
Water grass	4.77	1.45	44.94	38.15	3.69	.377	.313

SUMMARY

A riverfront pasture was divided into five lots and grazed as follows: lot I, unimproved, grazed with cattle; lot II, improved by discing and seeding with station rye grass, white Dutch clover, and black medic, grazed with cattle; lot III, unimproved, grazed with sheep and cattle; lot IV, unimproved, grazed with sheep; and lot V, improved by discing and seeding with station rye grass and white Dutch clover, grazed with sheep. The results obtained may be summarized as follows:

1. Discing and seeding resulted in marked improvement of cattle pastures, but not so marked gains of sheep pastures. When grazed by steers or heifers, the unimproved cattle pasture produced an average of only 161 pounds of gain to the acre, while the improved cattle pasture produced an average of 248 pounds of gain to the acre. When grazed with cows and calves, ewes and lambs, or both, the acre gains were as follows: Lot I, cattle, unimproved pasture, 225 pounds; lot II, cattle, improved pasture, 335 pounds; lot III, cattle and sheep, unimproved pasture, 339 pounds; lot IV, sheep, unimproved pasture, 12 pounds; lot V, sheep, improved pasture, 12 pounds.

The marketable gains per acre, that is, the gains made by calves and lambs, are as follows: Lot I, unimproved pasture, calves, 151 pounds; lot II, improved pasture, calves, 203 pounds; lot III, unimproved pasture, calves and lambs, 220 pounds; lot IV, unimproved pasture, lambs, 12 pounds; lot V, improved pasture, lambs, 14 pounds.

These figures show the marked gains from improving pasture for cattle, as well as the beneficial effect of grazing sheep and cattle together. They also show the futility of attempting to make economical gains from grazing riverfront pasture with sheep alone.

2. The average final weights of the calves and lambs of the various lots were: Lot I, unimproved pasture, calves, 387 pounds; lot II, improved pasture, calves, 400 pounds; lot III unimproved pasture, calves 446 pounds, lambs 63 pounds; lot IV, unimproved pasture, lambs, 43 pounds; lot V, improved pasture, lambs, 47 pounds.

These figures show that improvement of pasture results in marked improvement of calf weights, but not in lamb weights. They also show the heaviest average weight for calves and lambs to have been produced on a sheep and cattle pasture.

3. Both cows and calves continue to gain on riverfront pasture until the middle of October or the first of November.

4. Drenching studies with lambs indicate that neither a one per cent bluestone solution nor a solution containing one per cent bluestone plus one

per cent nicotine sulphate, when administered at the rate of 1.2 c.c. to the pound live weight, is effective in reducing stomach worm and other parasitic damages. The average weaning weights of drenched and undrenched lambs are as follows: Lot I, check lot, undrenched, 52.8 pounds; lot II, bluestone drench, 52.1 pounds; lot III, bluestone plus nicotine sulphate drench, 50.8 pounds.

5. Grazing sheep with cattle at the rate of one cow and calf plus one ewe and lamb to approximately one and three-fourths acres resulted in heavier lambs and no death losses than did grazing lambs and ewes alone. This system of grazing was more effective in controlling internal parasites in lambs than was drenching. The lambs grazed with cattle averaged 63 pounds at weaning time; those grazed on sheep pastures averaged 46 pounds and 49 pounds respectively.

6. Grazing cattle and sheep together did not increase the parasitic infestation of calves. On the contrary, calves raised as were the ones in lot III had fewer internal parasites than calves raised in the regular cattle pastures.

7. Pastures grazed exclusively with cattle showed a preponderance of Bermuda grass; the pasture grazed with cattle and sheep showed a comparatively higher percentage of Dallis grass; those grazed by sheep alone had higher percentages of broom sedge, a grass the sheep refused to eat. These differences became very marked during the last year of the experiment.

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ACKNOWLEDGMENTS

The author acknowledges the assistance of the following in obtaining results herein noted and in preparing the bulletin for publication:

Dr. Roy L. Mayhew, Parasitologist, Louisiana Experiment Station, for making all parasitical counts.

Harry P. Gayden, Instructor in Animal Industry and Dairying, L. S. U., and S. E. McCraine, graduate student, Louisiana State University, for assistance in carrying out the project.

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